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No. 430

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GEOPHYSICS, ASTRONOMY AND SPACE

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This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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I. ASTRONOMY

Abstracts of Scientific Articles

PHENOMENA OBSERVED IN SOLAR CONVECTION

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 55, No 4, 1978 pp 800-810

[Article by V. P. Savchenko and N. I. Kozhevnikov, Institute of Applied Geophysics and State Astronomical Institute, "Solar Convection"]

[Abstract] Ideas concerning the dynamics of tier-cell movements in the convective zone on the sun are developing. In a laminar approximation the authors have derived a dependence of cell flattening in a meridional section on the depth of its lower base. Under the same assumption it was possible to find the probability density functions that a cell in a particular tier has the area (S), horizontal dimension (L), mass (M), maximum velocity of circulation (v) and also the interrelationship of these parameters. The article gives the characteristic lifetimes of cells in different tiers, dimensions and most probable velocities of circulation in them. The article gives a qualitative examination of changes in distribution functions with an increasing influence of turbulence. A comparison of the results with observations shows that turbulence begins to have an effect with circulation velocities greater than those most probable for a particular tier. With degradation of the spot the states in which its areas become equal to the areas of the indicated cells are most stable.

[556]

DEVIATIONS FROM RHYTHMIC STRUCTURE OF WOLF NUMBERS

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 55, No 4, 1978 pp 811-822

[Article by K. S. Voychishin, Physical-Mechanical Institute, Ukrainian Academy of Sciences, "Analysis of Amplitude-Phase Disturbances of Rhythmic Structure of Wolf Numbers"]

[Abstract] A time series of Wolf numbers is regarded as a stochastic signal with irregular disturbances of a rhythmic structure appearing as a result of random variability of the parameters of individual cycles. The author

proposes a method and algorithm for signal transformation which makes it possible to reduce all the quasi-11-year cycles of mean monthly Wolf numbers to a uniform mean duration, to detect and exclude phase disturbances of the rhythm. The author evaluates the accuracy of this transformation procedure. The article gives the results of computations in the interval of the mean duration of the cycles for evaluations of their mathematical expectation, dispersion and the correlation function in dependence on time and the time shift. The conclusion is drawn that a time series of Wolf numbers can be interpreted as a sequence of statistically stable cycles with a randomly changing amplitude, duration and phase. The possibility of reducing the prediction of the mean monthly smoothed Wolf numbers for one or more cycles in advance to prediction of only the three above-mentioned parameters is indicated.

[556]

SATELLITE MODEL OF POTENTIAL ON PHYSICAL SURFACE OF PLANET

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 55, No 4, 1978 pp 862-872

[Article by N. A. Chuykova, State Astronomical Institute, "Applicability of a Satellite Model of Potential on the Physical Surface of a Planet"]

[Abstract] In order to find the distribution of potential and its derivatives on a physical surface and also in order to ascertain the Stokes constants on the basis of gravimetric measurements on the surface it is possible to use a formula for expansion of potential in spherical functions correct for satellite data. The errors in this case do not exceed $(H/r)^{4-k}$, where H is the mean height of the parts of relief extending above the sphere passing through the point of observation with the radius r, k is the order of the potential derivative. There is no need for preliminary regularization of the earth. However, attempts to introduce corrections for the influence of the protruding parts of the relief can lead to a substantial error when there is an inadequately precise allowance for relief.

[556]

LUNAR SEISMOTECTONICS ANALYZED

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 35-49

[Article by I. N. Galkin, Institute of Physics of the Earth, "Lunar Seismotectonics"]

[Abstract] This article gives a generalization of published Soviet and foreign data on the internal structure and seismicity of the moon. The tectonic passivity of the moon is governed by the characteristics of its deep structure,

the existence of a rigid, cold lithosphere extending to half its radius. The decisive role in the seismic regime of the moon is played by the endogenous forces of the gravitational fields of the earth and sun. The latest data indicate the existence of a spatial-temporal interrelationship of lunar quakes of a tidal and tectonic nature and also rapidly transpiring phenomena on the surface. All these events are localized in narrow zones of global dimensions constituting zones of lunar neotectonics. A reconstruction of the thermal history of the moon indicates an early attenuation of magmatic processes and timely cooling of the deep layers. The geophysical fields and peculiarities of lunar tectonics are discussed in comparison with the earth.

[553]

DETERMINATION OF RIGHT ASCENSIONS OF MERCURY

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 4, No 7, 1978 pp 328-331

[Article by P. M. Afanas'yeva and V. A. Fomin, Main Astronomical Observatory, "Determination of Right Ascensions of Mercury Using the RATAN-600 Radiotelescope"]

[Abstract] Observations with the RATAN-600 radio telescope in April-August 1977 indicated that the use of the characteristic radioemission of Mercury in the centimeter range makes it possible to ensure determination of its coordinates in the entire orbit, including in the immediate neighborhood of the sun. The observations involved determination of the moments of transit of Mercury and reference sources through the middle of the directional diagram of the radiotelescope operating as a transit instrument. The observations were made simultaneously in the ranges 1.35, 2.08, 3.9, 8.2 and 13 cm. The mean square error in one observation of Mercury relative to the reference radio sources, reduced to the equator, at a wavelength of 2.08 cm was $\pm 0^s.096$; the error in one observation of a reference source is $\pm 0^s.02-0^s.05$. The results of the experiment indicate that position observations of Mercury with the RATAN-600 are even now close in accuracy to optical observations of the planet.

[560]

II. METEOROLOGY

Abstracts of Scientific Articles

EFFECT OF AEROSOL ATTENUATION ON DETERMINING OCEAN-ATMOSPHERE TEMPERATURES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 7, 1978 pp 723-732

[Article by M. S. Malkevich and B. Z. Petrenko, Institute of Oceanology,
"Influence of Aerosol Attenuation on the Accuracy in Determining Temper-
ature of the Ocean and Atmosphere by Remote Methods"]

[Abstract] The authors discuss data published in the literature on the errors in reconstructing the temperature of the underlying surface and the vertical temperature profile on the basis of the earth's outgoing radiation in the CO₂ absorption band 15 μm and in the "transparency window" 10-12 μm, associated with failure to take aerosol attenuation into account. The experimental data indicate a considerable contribution of aerosol to the general attenuation of radiation, whereas according to the results of model computations the errors in reconstruction caused by aerosol in most cases do not exceed 1°K. This discrepancy is attributable to the existence of quite dense aerosol formations (undergoing transition into optically thin cloud cover) in cold layers of the atmosphere. The article gives evaluations of the dependence of reconstruction errors on the altitude and optical thickness of the layer (numerical experiment).

[547]

VARIABILITY OF TROPICAL CLOUD COVER AS INDICATOR OF DYNAMIC PROCESSES

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA. GEOGRAFIYA in Russian No 3, 1978
pp 100-105

[Article by A. V. Kislov, Climatology and Meteorology Department, Moscow University, "Variability of Tropical Cloud Cover as Indicator of Dynamic Processes in Atmosphere"]

[Abstract] The cloud cover of the tropical part of West Africa and the Atlantic Ocean is determined by large-scale processes — the influence of the Azores anticyclone and the ICZ. The overall variability of cloud cover

is minimum in the ICZ region. The variability is determined primarily by variations with a period of approximately 4 and 9 days. These variations are clearly manifested in the entire tropical zone, except in the ICZ, where their intensity decreases. The observed four-day variations are probably associated with the well-known easterly waves. The observed wavelength (2,000 km) coincides with most of the estimates made by other authors. It is important that the results obtained here by the use of harmonic analysis on the basis of extensive data agree with qualitative estimates made by synoptic analysis. Disturbances are generated in the depths of the African continent and are intensified near the coast in the zone of interaction between continental and monsoonal tropical air and are then transported in a westerly direction, gradually attenuating. Variations with a period of 9 days (wavelength (6,300 km) are possibly associated with disturbances existing in the upper troposphere and lower stratosphere. If this is correct, such waves should be accompanied by vertical movements affecting a great part of the troposphere.

[554]

ROLE OF CLOUD COVER IN SIMPLE CLIMATE MODELS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 8, 1978 pp 803-814

[Article by G. S. Golitsyn and I. I. Mokhov, Institute of Atmospheric Physics, "Evaluations of the Sensitivity and Role of Cloud Cover in Simple Climate Models"]

[Abstract] On the basis of a zonal model of climate, using the energy balance equation, a study was made of the influence exerted on the characteristics of the sensitivity of climate by changes in the parameterization constants for the correlation between outgoing radiation and the temperature of the earth's surface, variations in the extent of cloud cover, ice albedo and other factors. It was found that parameterization appreciably increases the "reserve" of climatic stability in the model with respect to transition to a "white earth regime," especially with allowance for the dependence of cloud albedo on solar zenith angle. At the same time, the rate of advance of the ice boundary with a decrease in mean global temperature is found to agree with data on Quaternary glaciations. The influence of the increase in energy production on the position of the boundary of a constant snow-ice cover is estimated.

[578]

METHOD FOR RADIOACOUSTIC SOUNDING OF ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 8, 1978 pp 824-832

[Article by A. I. Kon and O. G. Nalbandyan, Institute of Atmospheric Physics,
"Radioacoustic Sounding of the Atmosphere by Continuous Sound Radiation"]

[Abstract] In contrast to the traditional pulsed method, a study is made of the possibility of radioacoustic sounding of the atmosphere by continuous sonic radiation and also sonic radiation of a variable frequency (it is assumed that the radio signal is continuous and monochromatic). The authors have made a comparative analysis of the accuracy in determining the parameters of the atmosphere during sounding by each of the three methods. It is shown that for real parameters of the atmosphere the proposed sounding methods give a greater accuracy in comparison with pulsed methods.
[578]

THREE-DIMENSIONAL MODEL OF DROPLET CUMULUS CLOUD

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 8, 1978 pp 876-886

[Article by Ye. L. Kogan, Central Aerological Observatory, "Three-Dimensional Numerical Model of a Droplet Cumulus Cloud Taking Microphysical Processes into Account"]

[Abstract] The author presents a three-dimensional model of a droplet cumulus cloud with a description of microphysical processes on the basis of kinetic equations for 30 groups of droplets from 4 to $3,250 \mu\text{m}$ and 19 groups of condensation nuclei from 0.008 to $7.6 \mu\text{m}$. The dynamic processes are described using the equations for intense convection in the Boussinesq approximation. Numerical methods are used which ensure a high accuracy in the solution: a Lagrangian-Eulerian model for computations of nucleation, condensation, evaporation; Berry and Reinhardt method for coagulation and breakdown of droplets; splitting method with a predictor-corrector model for computing the dynamic characteristics of a cloud. The article presents the results of a numerical experiment in which there is modeling of the development of a cumulus cloud of the marine type. It is shown that heating of the cloud periphery by descending compensation currents leads to the formation of multicellular convection and the appearance of cross flows in the cloud. The artificial suppression of ascending currents carried out in the model experiment leads to a rapid precipitation of cloud water. This fact can be of practical interest in the artificial modification of precipitation-forming processes.
[578]

NUMERICAL EXPERIMENTS WITH MODEL OF ZONAL CIRCULATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 7, 1978 pp 691-702

[Article by S. Ye. Kirichkov, Institute of Atmospheric Physics, "Numerical Experiments with a Model of Zonal Circulation of the Atmosphere"]

[Abstract] In this study the author investigates the influence exerted on the formation of zonal circulation, first by the semiempirical coefficients used in closing zonally averaged equations and second, by the angular velocity of the earth's rotation Ω , which is one of the decisive parameters in formation of the climate of the earth and other planets. The basis for the work was a model of zonal circulation proposed by F. V. Dolzhanskiy (IZV. AN SSSR, FAO, 5, No 7, 1969). The following changes have been introduced into this model: in the equation for the zonal component of mean velocity a dissipative term has been introduced which takes into account the influence of horizontal small-scale turbulence and a finite-difference approximation of the equations is used which makes it possible to increase the time intervals and to carry out computations for stationary states of a long duration. A study is made of the influence of change in the coefficients of turbulent exchange and angular velocity of the earth's rotation on the formation and intensity of zonal and meridional circulation. The resulting zonal circulation coincides qualitatively with the real circulation, although the intensity of meridional circulation and kinetic energy of the zonal flow are too low.

[547]

III. OCEANOGRAPHY

Abstracts of Scientific Articles

THERMAL EMISSION OF PERIODICALLY UNEVEN WATER SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 7, 1978 pp 733-739

[Article by Yu. A. Kravtsov, Ye. A. Mirovskaya, A. Ye. Popov, I. A. Troitskiy and V. S. Etkin, Space Research Institute, "Critical Phenomena in Thermal Emission of Periodically Uneven Water Surface"]

[Abstract] The authors have computed the thermal emission of a well-conducting sinusoidal surface under conditions when the length of the electromagnetic wave is comparable with the period of surface unevenness and the wave vector of the wave surface is parallel to the observation plane. Computations were made by the perturbations method with the use of Leontovich boundary conditions. It was possible to detect critical effects characteristic for the diffraction of electromagnetic waves on periodic structures. The derived relationships are of interest for an interpretation of measurements of thermal radioemission of the sea surface.

[547]

NUMERICAL MODEL FOR STUDYING SYNOPTIC EDDIES IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 7, 1978 pp 757-767

[Article by D. G. Seidov, Institute of Oceanology, "Numerical Model for Investigation of Synoptic Eddies in the Ocean"]

[Abstract] A numerical model of synoptic currents in the ocean based on a Eulerian-Lagrangian scheme is discussed. The author demonstrates the advantage of this quasi-Lagrangian approach in modeling of advection processes. The scheme is stable and has a lesser viscosity in comparison with traditional Eulerian schemes. The evolution of currents from a state of rest under the influence of fluxes of heat and momentum through the ocean surface is demonstrated. It is shown that there is a qualitative agreement between the

computed and observed values and the results obtained in other studies with numerical modeling of currents in the ocean. The article discusses the possible mechanism of appearance of an eddy structure and the requirements imposed on the numerical models.

[547]

ANALYSIS OF SPECTRA OF TRAPPED WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 7, 1978 pp 748-756

[Article by V. V. Yefimov and Ye. A. Kulikov, Sakhalin Multidiscipline Scientific Research Institute, "Use of the Method of Adaptive Evaluation of Spatial-Temporal Spectra in an Analysis of Trapped Waves"]

[Abstract] Within the framework of a long-wave approximation a study was made of a numerical model of propagation of trapped waves on the ocean shelf in the Kurile arc and dispersion relationships were computed. On the basis of data from synchronous multipoint measurements of bottom pressure in the ocean and using archival data from mareographic stations in the Kurile Islands it was possible to compute the spatial-temporal spectra of ocean level fluctuations. It is shown that there is a coincidence of positions of the maxima in the spatial spectra and the values of the wave vectors computed from a numerical model for frequencies 0.38 hour^{-1} (zero mode of the Kelvin edge wave) and $0.008-0.012 \text{ hour}^{-1}$ (first mode of the shelf wave). The author demonstrates the advantage of use of evaluations of the spatial-temporal spectra by the maximum similarity method in comparison with the traditional method.

[547]

SPECTRAL INEQUALITIES FOR TWO-DIMENSIONAL TURBULENCE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 14, No 6, 1978 pp 668-671

[Article by Ye. A. Novikov, Institute of Physics of the Atmosphere, "Spectral Inequalities for Two-Dimensional Turbulence"]

[Abstract] Large-scale movements in the ocean and atmosphere usually have a two-dimensional nature. An important characteristic of two-dimensional turbulent currents is a reverse flow of energy (from small to large scales), accompanied by a vorticity flux from large to small scales. An earlier study by the author (TURBULENTNYYE TECHENIYA, "Nauka," 85-94, 1974) gave an explanation of the directed transfer of energy in the spectra of three- and two-dimensional turbulence and also transfer of vorticity from large to small scales in two-dimensional turbulence. The basis used for this work was the statistical principle close to the ideas of Boltzmann and Gibbs in molecular statistics. However, the examination presented in this earlier study was quite complex and therefore the purpose of this article was to present the derivation of simple spectral inequalities which considerably clarify the laws and patterns of two-dimensional turbulent currents.

[512]

FACTORS GOVERNING ROUGHNESS PARAMETER FOR WATER SURFACE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA. GEOGRAFIYA in Russian No 3, 1978 pp 105-110

[Article by A. S. Kaz'min and A. V. Shumilov, Oceanology Department Moscow State University, "Dependence of the Roughness Parameter of a Water Surface on Wind Velocity and the Degree of Surface Contamination"]

[Abstract] The thickness of the viscous layer over a solid surface is less than over a water surface. This is attributable to the fact that in the latter case there are two additional mechanisms suppressing the energy of turbulence: the fluid surface is entrained into motion and is curved. At the time of formation of capillary waves (with a wind velocity of about 1.5 m/sec) the roughness of the water surface increases and then begins to decrease. With an increase in wind velocity (at least to moderate) the roughness of the water surface decreases. The authors believe that when there are weak winds the aerodynamic properties of the water surface are determined by waves of the capillary and capillary-gravitational interval. The proposed model shows the mechanism of the influence of capillary waves on the structure of the air flow over the liquid surface. With contamination of the water surface the roughness is reduced but the influence of contamination is significant only in the case of small wind velocities (approximately up to 6 m/sec). Thus, the wind velocity over contamination spots

is greater than over a clean surface. It is shown that a decrease in the roughness parameter decreases energy transfer from the atmosphere to the ocean.

[554]

SEA GEOTHERMAL ANOMALIES ANALYZED

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1978 pp 77-82

[Article by V. V. Sochel'nikov and V. G. Zolotarev, Southern Division Institute of Oceanology, "Nature of Sea Geothermal Anomalies"]

[Abstract] A layer of sea water considerably reduces temperature anomalies in the upper layer of sediment. In the heat flow method the effective depth of investigation of bodies of isometric configuration does not exceed the characteristic dimensions of the objects. The temperature anomalies detected by the bottom geotemperature survey method are not caused by the contrast of conductive thermal conductivity but by the additional receipt of heat, and in particular, by convective transfer along tectonic faults. In order to obtain comparable results in temperature measurements it is necessary to submerge the sensor to a constant depth. In order to increase resolution and exclude errors due to a change in the depth of sensor submergence it is recommended that in the bottom geotemperature survey method measurements be made of the vertical derivative of temperature.

[552]

STRUCTURE OF INTERNAL WAVES IN THE CASPIAN SEA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA. GEOGRAFIYA in Russian No 4, 1978 pp 94-101

[Article by A. S. Blatov and V. A. Ivanov, Oceanology Department, Moscow State University, "Structure of Internal Waves in the Caspian Sea"]

[Abstract] This paper presents the results of an experimental investigation of the vertical structure of short-period internal waves in the Caspian Sea. Data on the vertical structure of internal waves were recorded during the period 1972-1975. A comparison of the actual results obtained with a series of numerical computations has shown that the parameters of internal waves are to a considerable extent determined by the vertical hydrological structure. A typological classification and regionalization of the Caspian Sea area in terms of the vertical profile of the Väisälä frequency is presented and dispersion curves for certain sea areas are calculated. These curves enable the parameters of short-period internal waves to be evaluated for the entire Caspian Sea area.

[573]

IV. TERRESTRIAL GEOPHYSICS

Abstracts of Scientific Articles

CURRENT PROBLEMS OF GEODETIC NETWORKS

Budapest GEODEZIA ES KARTOGRAFIA in Hungarian Vol 30, No 3, 1978 pp 167-171

[Article by Jozsef Somogyi]

[Abstract] A major step forward was the introduction of electronic distance-measuring instruments. They permit direct measurement of long spatial distances and also the determination of spatial directions. Both types of data are virtually independent of the earth's gravitational field. Because of difficulties created by the increased distance from the geoid, the simplest method is to view the measurement results in a three-dimensional configuration and to make the calculations in three-dimensional Euclidean space. We thus obtain spatial distances, spatial directions and geometric configurations formed from spatial angles. There are directional, angle and distance networks, as well as combinations of these. Those networks in which the signals are carried by satellites, aircraft or ships are always dynamic networks; the static networks have only permanent points. Measurement difficulties in dynamic networks (the difficulties depend on the speed at which the moving point travels) may be reduced by optimum network configuration and proper selection of the moving points. In the case of dynamic satellite systems, the laws governing satellite movements may also be used for this purpose. The importance of photogrammetric networks increased as a result of advances in computer technology. Satellite techniques may be used to increase the accuracy of permanent terrestrial points and to monitor their movements.

[479]

VELOCITY ANOMALIES OF UPPER MANTLE IN CAUCASUS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1978
pp 22-31

[Article by L. P. Vinnik, A. A. Godzikovskaya, Ye. I. Pataraya, D. I. Sikharulidze and A. Kh. Bagramyan, Institute of Physics of the Earth, "Velocity Anomalies of Upper Mantle in Caucasus"]

[Abstract] The authors propose a new map of horizontal variations of the velocity of longitudinal waves in the upper mantle of the Caucasus. The map was constructed by the method of projection of nonclosure of the travel times of 25 seismic stations at a depth of 150 km, corrected for the crust, and smoothing of the resulting numerical field in a moving square with a side of 100 km. The principal characteristic of the discriminated velocity variations is submeridional zonality, different from tectonic zonality. The authors discuss the relationship of these variations to heat and gravity fields and the location of foci of large earthquakes. The nonclosures, associated with horizontal inhomogeneities of the upper mantle, are observed against a background of a strong azimuthal dependence, interpreted as a manifestation of anisotropy of velocities.

[552]

METHOD FOR STUDYING FOCUS OF LOCAL EARTHQUAKE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1978
pp 32-42

[Article by G. A. Vostrikov, Institute of Physics of the Earth, "Study of the Focus of a Local Earthquake from the Amplitudes of the Coda and Regular Waves"]

[Abstract] A study was made of the dependence $T_p \sim T_s$ between the durations of the signals of longitudinal and transverse waves emitted by an earthquake focus in different directions. It is proposed that the durations be measured from the ratios of the amplitudes of the coda and the mean amplitudes of trains of longitudinal and transverse waves registered by wide-band instrumentation. The calibration of these ratios in time units is carried out using independent measurements of T_p and T_s from the ChISS spectra. The dependences were used in measuring the focal time of 350 local earthquakes in the Garm region of Tadzhikistan. The author has determined the dependence of focal time on the seismic moment of the earthquake focus. It is demonstrated in two examples that the intensity of sources of weak earthquakes is decreased prior to strong ($K = 13$) tremors. A decrease is observed over a great area. It can serve as a prognostic criterion.

[552]

KINEMATIC MODEL OF MOVEMENT OF CRUSTAL BLOCKS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1978
pp 25-32

[Article by N. A. Fandyushina, Institute of Physics of the Earth, "Kinematic Model of Movement of Crustal Blocks in the Garm Geodynamic Polygon"]

[Abstract] The movement of crustal blocks in the Garm geodynamic polygon was investigated. The already existing model of a translational overthrust along the slanting plane of the block belonging to the Peter I Range onto the Gissarskiy block is supplemented by relative turning of the blocks. With an angular velocity of rotation of about $5.58 \cdot 10^{-6}$ rad/year the model explains the observed difference in the mean velocities of the vertical component of motion of "fast" benchmarks in the polygon obtained during levelings. At the same time it was possible to estimate the probable rate of the translational movement and the overthrust angle.

[572]

FRACTURING OF CRUST DETERMINED FROM STATISTICS ON FOCAL MECHANISMS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1978
pp 33-45

[Article by A. A. Lukk and V. G. Leonova, Institute of Physics of the Earth, "Fissuring of the Earth's Crust in the Garm Region Determined from Statistics on Focal Mechanisms of Weak Earthquakes"]

[Abstract] The authors have analyzed the form and temporal stability of the distributions of dynamic parameters of foci of weak earthquakes ($M \geq 1.5$) in the Garm region for nine years of observations. It is shown that the spatial orientation of the axes of the principal stresses occurring in earthquake foci has a clearly expressed anisotropy. This makes it necessary to assume that the deformation of the earth's crust in the investigated region occurs for the most part along definite systems of dislocations. Three predominant directions can be discriminated in the strike of the planes of movements at earthquake foci: 0, 50 and 90°, with a predominance of their dips in the range 55-85°. Use is made of a formal procedure for an unambiguous choice of the movement plane. By virtue of the great spatial distribution of the centers of earthquakes with a strike of the planes of movement in the directions 0 and 90° it is postulated that this "seismic fissurability" determines for the most part the structure of the overall fissurability of the upper 5-10 km of the earth's crust in the Garm region up to the level of microdislocations, which can lead to an anisotropy of the elastic properties of the medium. This fissuring must constitute a dynamic system because there are appreciable variations in the number of "fissures" with a strike of 90° per unit volume with time ("closed" and "open" fissures).

It is postulated that these variations can cause changes in the effective elastic moduli of the medium (especially the μ modulus) in connection with the change in the intensity of the frictional force between the sides of the fissures ("closed" and "open" fissures); this can lead in the long run to the earlier observed variations in the velocities of elastic waves during their propagation across this fissuring.

[572]

LONGITUDINAL WAVES IN LINEAR VISCOELASTIC MEDIA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1978
pp 46-53

[Article by G. M. Lyakhov and K. S. Sultanov, Mechanical Institute, Moscow State University, "Longitudinal Waves in Linear Viscoelastic Media"]

[Abstract] In studying the structure of the earth's crust extensive use is made of the use of the results of experimental investigations of longitudinal waves. A theoretical analysis of the laws of propagation of longitudinal waves is based on different model representations. In particular, there is an analytical solution of the problem of propagation of a longitudinal sinusoidal wave on the basis of a model of a linear viscoelastic medium (standard linear body). Here the authors give a solution of the problem of propagation of a plane wave in a half-space. The wave is created by a sinusoidal load which is imparted at an initial moment in time, uniformly distributed over the entire surface of the half-space. A model of a linear viscoelastic medium is used. The solution was obtained on an electronic computer in accordance with a method developed for shock waves. Such an analytical solution corresponds to steady sinusoidal oscillations and does not give a full description of the wave in the case of a load imparted at some moment in time.

[572]

DETERMINING FIGURE OF EARTH IN MOUNTAINOUS REGIONS

Warsaw GEODEZJA I KARTOGRAFIA in Polish Vol 27, No 2, 1978 pp 95-100

[Aniela Makowska and Zbigniew Zorski]

[Abstract] The article gives a refraction model used in determining plumb-line deflections on the basis of an adjusted trigonometric leveling network in mountainous regions. It follows from the analysis that a model with a constant coefficient of the earth's refraction at the observed station is not always correct, especially for directions passing along slopes with

unlike insolation and with different surface coverings of the terrain in the neighborhood of the station. Therefore, especially for points situated about 1,100 m above sea level, it is proposed that in the adjustment use be made of a model with a group coefficient of the earth's refraction at a station. The analysis was based on observations made in the Polish Tatry.

[575]

ANNULAR STRUCTURES IN SOUTHEASTERN SIBERIA

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 50-63

[Article by M. Z. Glukhovskiy, Aerogeological Combine, "Annular Structures in Southeastern Siberia and Their Possible Nature"]

[Abstract] A study was made of annular structures with a large diameter which were clearly detected as a result of interpretation of television space photographs of the earth. On the basis of their identification with known elements of tectonics, magmatism and deep structure of individual regions it is postulated that concentric-annular structures of the earth are a special type of tectonically active zones characterized by antiquity of formation, great depth and duration of development. Being formed in all probability in the lunar stage of the earth's development, during the entire course of the earth's geological history they retained their principal morphological characteristics and tectono-magmatic activity. In some regions the spatial structures conform to the spatial distribution of various magmatic complexes and the mineral deposits associated with them.

[553]

PALEOZOIC MAGMATISM AND METAMORPHISM IN GREATER CAUCASUS

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 64-69

[Article by G. M. Zaridze and D. M. Shengelia, Geological Institute Georgian Academy of Sciences, "Magmatism and Metamorphism in the Paleozoic in the Greater Caucasus in the Light of Tectonics of Lithospheric Plates"]

[Abstract] On the basis of materials from the Greater Caucasus the authors have examined the magmatic processes, which transpire in stages, different types of metamorphism and granite formation of the plagiogranodiorite and granite formations against a background of development of orogenic zones from the points of view of the hypothesis of the tectonics of plates. It is noted that at the edge of a plunging lithospheric plate a zone of metamorphic rocks with increased pressure was formed, whereas low-pressure high-temperature regional metamorphism transpired within the limits of the continental crust in the stage of folded deformations at relatively small depths.

[553]

DEEP STRUCTURE OF THE SOUTHERN ARAL REGION

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 4, 1978 pp 50-53

[Article by V. N. Bashayev and Kh. Kh. Inogamov, Institute of Geology and Exploration of Petroleum and Gas Deposits, Geology Ministry, Uzbek SSR, "Deep Structure of the Southern Aral Region"]

[Abstract] In the study of the deep structure of the southern Aral region the principal source of information has been data from seismic, gravimetric and drilling work. The region consists of Precambrian formations, forming the crystalline basement, Paleozoic, constituting the folded basement, and Mesozoic-Cenozoic, forming the upper stage, the platform cover. The Conrad discontinuity is characterized by relatively gentle relief. A sharp decrease in its depth to 19 km is noted in the southern part of the region. In radial directions from this zone the surface plunges to 21 km. The depth of the Moho is 39-40 km, locally plunging to 42-43 km. In general, for the southern Aral region there is a correspondence of the structural plans of the stratigraphic complexes of the sedimentary cover and the basement, except for the Paleogene erosional surface. The relatively simple, inherited nature of the structure of the sedimentary cover is determined for the most part by the morphostructure of the upper part of the crystalline basement, that is, the main uplifts and downwarps. The absence of correlations between the surfaces of the folded basement, K and M surfaces is indirect evidence of an independent mechanism of formation of each of these. These characteristics of crustal structure for different tectonic zones can be used in solving problems in the tectonic regionalization of Paleozoic formations.

[550]

METHOD FOR DETERMINING EARTHQUAKE INTENSITY INCREMENTS

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 4, 1978 pp 19-22

[Article by S. M. Kasymov, R. A. Tillyabayev, Ya. K. Kamalov and Z. Kalibayev, Seismology Institute Uzbek Academy of Sciences, "Determination of Earthquake Intensity Increments in Individual Territories of the Central Kyzylkum by the Seismic Rigidities Method"]

[Abstract] Seismic rigidity is the principal physical characteristic of the ground. This is the product of the velocity of seismic waves and density. In a number of sectors in Uzbekistan it was possible to determine the increments of earthquake intensity by the seismic rigidities method. For this purpose field seismic reconnaissance was carried out by the refracted waves method for determining the velocity of wave propagation in the upper part of the geological section. Ground density was measured using radioisotopic apparatus. In the investigated sectors the thickness of this zone is from

3 to 20 m. One of the necessary conditions for computing increments of seismic intensity is a determination of the "mean" ground conditions for the region. In these computations it is also necessary to ascertain the thickness of the ground layers where the seismic effect changes most frequently. The thickness of this layer is 10 m. Two curves are constructed for determining mean ground conditions: 1) a curve of the distribution of the velocity of longitudinal seismic waves and a curve of the density of the 10-m ground layer. Analysis of these curves indicates that in most parts of the investigated area the velocity of longitudinal waves is 830 m/sec and the density is 1.8 g/cm^3 . These values were used as the mean conditions in computations of increments of seismic intensity in the area. These data can serve as initial data in seismic microregionalization of the investigated territories.

[550]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

News

TASS ANNOUNCES LAUNCHING OF "KOSMOS-1030"

Moscow PRAVDA in Russian 7 Sep 78 p 2

[TASS Report: "'Kosmos-1030'"]

[Abstract] The artificial earth satellite "Kosmos-1030" was launched in the Soviet Union on 6 September 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 12 hours 6 minutes;
- apogee, 40,100 kilometers;
- perigee, 650 kilometers;
- orbital inclination, 62.8 degrees.

[558]

TASS ANNOUNCES LAUNCHING OF "MOLNIYA-1" COMMUNICATIONS SATELLITE

Moscow PRAVDA in Russian 24 Aug 78 p 1

[TASS Report: "'Molniya-1'"]

[Text] On 23 August 1978 a "Molniya-1" communications satellite was launched in the Soviet Union. The "Molniya-1" communications satellite is intended for operation in the system of long-range telephone and telegraph radio communication and also for transmission of USSR Central Television programs to points in the "Orbita" network situated in regions of the Far North, Siberia, the Far East and Central Asia.

The satellite was inserted into a high elliptical orbit with the following parameters:

-- apogee, 40,788 kilometers;
-- perigee, 480 kilometers;
-- period of revolution, 12 hours 16 minutes;
-- orbital inclination, 62.8 degrees.

In addition to the apparatus for transmission of television programs and for providing long-range multichannel radio communication, the satellite has on-board a command and measurement complex and also systems for orientation, orbital correction and power supply for the satellite.

According to the data received, the apparatus installed on the satellite is functioning normally. Communication sessions using the "Molniya-1" satellite will be conducted in accordance with the planned program.
[557]

TASS ANNOUNCES LAUNCHING OF "VENERA-11"

Moscow PRAVDA in Russian 10 Sep 78 p 1

[TASS Report: "Start for the Planet of Mysteries"]

[Summary] In accordance with the program to study outer space and the planets of the solar system, the automatic interplanetary station "Venera-11" was launched from the Soviet Union on 9 September 1978. It was inserted into an intermediate orbit as an artificial earth satellite and from there was launched into a trajectory towards Venus. Scientific equipment on board was developed by specialists of the USSR and France and was designed to monitor and transmit information on the solar wind, cosmic rays, ultraviolet, gamma- and x-ray radiation even before it reaches Venus in December 1978. The flight of "Venera-11" is being controlled from the Center for Distant Space Communications. All systems are functioning normally. [5]
[563]

CHRONOLOGY OF "SALYUT-6" MISSION 25 AUGUST-7 SEPTEMBER 1978

[Editorial Report] Moscow PRAVDA in Russian, dated 26 Aug 78 through 8 Sep 78, TASS provides the following information on flight activities on board the "Salyut-6" orbital station:

25 AUGUST

25 August marked the end of the tenth week on board "Salyut-6" for cosmonauts Kovalenok and Ivanchenkov. The day was devoted to control checks of on-board systems and equipment, "housekeeping," exercise, television reporting and continued materials processing in "Kristall."

Parameters of microclimate within the station were given as:

-- temperature, 21 degrees Centigrade;

-- pressure, 810 mm Hg.

(PRAVDA 26 Aug 78 p 1)

26 AUGUST

"SOYUZ-31" LAUNCHED

Cosmonauts Valeriy Bykovskiy (USSR) and Sigmund Jaehn (GDR) were launched into orbit on board "Soyuz-31" at 1751 hours Moscow time on 26 August. This was the third international crew to fly on board a Soviet transport ship. (PRAVDA 27 Aug 78 p 1)

27 AUGUST

On 27 August at 1938 hours Moscow time "Soyuz-31" successfully docked with the "Salyut-6" station. (PRAVDA 28 Aug 78 p 1)

28 AUGUST

The working day for cosmonauts Kovalenok, Ivanchenkov, Bykovskiy and Jaehn began at 1230 hours Moscow time. The "Soyuz-31" crew underwent a comprehensive medical examination using the "Polinom-2M," "Beta" and "Reograf" instruments to monitor cardiovascular function. Bykovskiy and Jaehn were also involved in conducting experiments developed jointly by scientists of the USSR and the GDR to study the effect of spaceflight on the development of bacteria and tissue cultures and to process materials in the "Kris-tall" and "Splav" chambers (the East German materials processing experiment was known as "Berolina"). (PRAVDA 29 Aug 78 p 1)

29 AUGUST

In accordance with the program of medical research, cosmonauts Kovalenok and Ivanchenkov prepared blood samples to be returned to earth for laboratory analysis.

Cosmonauts Bykovskiy and Jaehn continued to conduct the "Berolina" materials processing experiment as well as biomedical experiments to study the development of microorganisms under the conditions of weightlessness.

It was announced that cosmonauts Bykovskiy and Jaehn would return in the "Soyuz-29" transport ship and were making the necessary preparations. (PRAVDA 30 Aug 78 p 1)

30 AUGUST

31 AUGUST

In accordance with the "Biosfera" (biosphere) experiment, the international crew conducted observations of the earth's surface, a variety of meteorological phenomena and polluted areas of the atmosphere and photographed

them with a camera developed by GDR specialists and delivered by the "Progress-3."

Medical research centered around an experiment to test the cosmonauts' sense of time as well as their sense of taste; the "Metabolizm" experiment was also completed. (PRAVDA 1 Sep 78 p 1)

1 SEPTEMBER

On their sixth day on board the space complex, cosmonauts Bykovskiy and Jaehn continued the "Biosfera" environmental studies experiment as well as the "Berolina" materials processing experiment. (PRAVDA 2 Sep 78 p 1)

2 SEPTEMBER

3 SEPTEMBER

On 3 September cosmonauts Bykovskiy and Jaehn softlanded in the "Soyuz-29" descent vehicle 140 kilometers southeast of Dzhezkazgan. (PRAVDA 4 Sep 78 p 1)

4 SEPTEMBER

4 September was a day of active rest for cosmonauts Kovalenok and Ivanchenkova. They tested the station's on-board systems and equipment, worked with flight documentation, observed and photographed the earth's surface and exercised on the trainer and bicycle ergometer.

Parameters of the microclimate within the station were given as:

- temperature, 20 degrees Centigrade;
- pressure, 790 mm Hg. (PRAVDA 5 Sep 78 p 1)

5-6 SEPTEMBER

7 SEPTEMBER

REDOCKING MANEUVER

On 7 September a maneuver to redock "Soyuz-31" to the transfer compartment of "Salyut-6" was executed. The redocking, which began at 1353 hours Moscow time, was necessary in order to free the equipment bay docking unit for unmanned cargo missions. (PRAVDA 8 Sep 78 p 1)

All of the TASS reports indicate that the cosmonauts have been in good health and that all on-board systems have been functioning normally. [5] [563]

Parameters of microclimate within the station were given as:

-- temperature, 21 degrees Centigrade;

-- pressure, 810 mm Hg.

(PRAVDA 26 Aug 78 p 1)

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- temperature, 20 degrees Centigrade;
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All of the TASS reports indicate that the cosmonauts have been in good health and that all on-board systems have been functioning normally. [5] [563]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-1031"

Moscow PRAVDA in Russian 12 Sep 78 p 3

[TASS Report: "'Kosmos-1031'"]

[Abstract] The artificial earth satellite "Kosmos-1031" was launched in the Soviet Union on 9 September 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.6 minutes;
- apogee, 351 kilometers;
- perigee, 191 kilometers;
- orbital inclination, 62.8 degrees.

[569]

TASS ANNOUNCES LAUNCHING OF "VENERA-12"

Moscow PRAVDA in Russian 15 Sep 78 p 1

[TASS Report: "Towards the 'Morning Star': 'Venera-12' in Flight"]

[Abstract] On 14 September 1978 the "Venera-12" automatic interplanetary station was launched from the Soviet Union. It has the same purpose and is structurally similar to "Venera-11," which was launched on 9 September. Both stations will monitor processes occurring in outer space and, by December 1978, will transmit to earth data on the planet Venus. [5]

[570]

FURTHER "SOYUZ-31" EXPERIMENTS OUTLINED

Moscow IZVESTIYA in Russian 2 Sep 78 p 2

[Article by B. Konovalov: "Proceedings of the Orbital Institute"]

[Excerpt] From aboard the station the cosmonauts are not only admiring our planet but are conducting visual observations under the program of the "Biosfera" experiment, prepared jointly by the Central Institute of Physics of the Earth GDR Academy of Sciences and the Soviet State Center "Priroda."

Using the "Pentakon" intermediate-format camera the most interesting pictures are printed on color and black-and-white films. These observations are assisting in the improvement of methods for remote sounding of the earth from space.

The cosmonauts on this flight are also regularly using their own kind of "heavy artillery" for remote sounding -- the MKF-6M multizonal camera developed jointly by specialists of the GDR and the USSR and fabricated at the People's Enterprise "Karl Zeiss Jena." From aboard the "Salyut-6" the camera is being used in regularly conducting a survey both of the territory of the Soviet Union and the socialist countries in the interests of geology, meteorology, services for the preservation of nature, agriculture, forestry and fishing.

During the time of presence aboard the "Salyut-6" P. Klimuk and M. Germashhevskiy began the "Vkus" experiment, whose purpose was to explain how taste sensations change in space. Now this experiment has been continued and it has been supplemented by several others. In the "Rech'" (Speech) experiment the physicians, making a detailed analysis of the peculiarities of pronunciation of one and the same phrase during the course of the flight, want to establish an objective relationship between the character of speech and the emotional state of the cosmonaut. In the "Vremya" experiment, which is carried out using the "Rula" (Rudder) electronic instrument, developed by specialists of the GDR, the international crew is assisting researchers in clarifying how the subjective sensation of time changes in the cosmonauts during the flight.

In the "Audio" (Audio) experiment it is necessary to determine the influence of a combination of spaceflight factors on the hearing of the cosmonauts. Using the "El'ba" (Elba) instrument, developed in the GDR, the cosmonauts will record the change in the audibility threshold in six frequency ranges. The cosmonauts by means of a special audiometer are also measuring the noise background of the station.

The psychological state is being studied in the "Opros" (Interrogation) experiment. The psychologists of the USSR, Polish People's Republic and Czechoslovakia have developed a special medical-psychological interrogation. Now it has been supplemented by problems and questions formulated by GDR psychologists.

As we see, the examination of man in space is being carried out on a broad front. In addition, physicians are carrying out traditional examinations of the cosmonauts and are obtaining electrocardiograms. According to their evaluation, the adaptation process in V. Bykovskiy and S. Jaehn has transpired well. And Valeriy Bykovskiy evidently is one of those rare cosmonauts who completely do not react to weightlessness. The main crew, which has already been working for 2 1/2 months in space, according to objective data from medical investigations, also feels well. Soon they will receive guests from the earth. The joint research program is coming toward its end.

[544]

COMMENTARY ON WATER REGENERATION SYSTEM

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Aug 78 p 3

[Article by Yu. Sinyak: "An Oasis in Space"]

[Text] The register of freight delivered aboard the "Progress-3" transport ship includes materials for scientific research and for ensuring the vital functioning of the cosmonauts. Another line in the list reads "drinking water." Moving on in boundless space, the complex can be compared with an oasis in the lifeless desert. And life is water. Doctor of Technical Sciences Yu. Sinyak tells today about how the water supply of spacecraft crews is organized.

On the earth different methods can be used for maintaining high qualities of drinking water: chlorination and ozone processing, use of UV or ionizing radiation, antibiotics, ultrasound, etc. But most of them are not suitable for space. Processing with ultrasound, ultraviolet or a high temperature requires increased energy expenditures; irradiation with beta- or gamma-rays is impossible without massive protection. Chlorine preparations can alter the taste qualities of the water.

That is why silver preparations are used aboard ships of the "Soyuz" type and "Salyut" orbital stations for the preservation of water. In Russian villages since long ago it has been the custom to drop silver coins in a pail in order to preserve water. The effectiveness of this popular method has been confirmed by scientists. Investigations have shown that ionic silver is one of the best preservatives, ensuring the storage of water without any changes in its quality.

On long expeditions it is impossible to store water for the entire time of the work. For example, the weight of the stored water increases on such a scale that for a crew of four men on a six-months flight it is 6-9 tons. Accordingly, it is necessary to use water regenerated from the products of man's vital functioning. A water supply system based on regeneration processes should operate reliably under weightlessness conditions and with the expenditure of little energy. Its design should be simple and convenient in operation, suitable for repair, stable to vibrations and shock overloads.

One of the variants of regeneration systems is now operating successfully on board the orbital scientific station "Salyut-6." By means of this apparatus water is regenerated from a condensate of atmospheric moisture which is formed as a result of the breathing and perspiration of the cosmonauts. The technological scheme includes the collection of moisture, segregation of the gas-fluid mixture, purification of water from organic, inorganic and microbiological impurities, from different solid particles. Then the water is decontaminated, preserved, saturated with macro- and trace elements and is heated.

For purification use is made of ion-exchange resins, activated charcoal and a mechanical filter. Enrichment with mineral components and preservation occur when the water passes through a slurry containing the corresponding salts and compounds of silver. Such a regeneration system makes it possible to recycle a considerable part of the daily needs of cosmonauts for drinking water. The crew uses regenerated hot water in preparing breakfast and lunch, tea and coffee. The remaining part of the water is taken by the cosmonauts from the reserves, which are replenished with each arrival of a transport ship.

The use of other regeneration systems will make it possible to carry out a complete cycling of water and to reduce the quantity of its reserves to a minimum. As a result, it will be possible to outfit scientific space laboratories with a great number of scientific instruments.

[559]

DOCKING OF "SOYUZ-31" DESCRIBED

Moscow PRAVDA in Russian 28 Aug 78 pp 1, 6

[Article by Yu. Apenchenko: "Rendezvous in Orbit"]

[Excerpts] We have a conversation with I. K. Bazhinov, director of the service.

"Preparations for the docking began before the 'Soyuz-31' was put in a launching position. First it was necessary to correct the 'Salyut' orbit appropriately. The station engines were fired three times, the last time two days before the ship was launched. After the 'Soyuz-31' had been put into orbit the angle of discrepancy between it and the station was to be 95°, in other words, approximately 10,000 kilometers."

"Is that a good result?"

"Yes, it can be said that it is optimum."

"Does it coincide with the initial computations?"

"It does coincide. But it must be remembered that it is known in advance that a complete coincidence is impossible, since after all, during the launching and in the active flight segment there will inevitably be some deviations and natural interference. In order to eliminate these provision is made for maneuvering of the ship during the first day of flight..."

"The first two-impulse maneuver was made on the fifth revolution of the ship around the planet. By firing the engine the velocity was first increased to 6 and then to 36 m/sec. The ship seemingly made the first 'jump' after the

station. This was probably the principal event of the first work shift for the crew prior to a break for rest..."

On Sunday evening the ship made still another "jerk" toward the "Salyut." The ballistics specialists carefully computed and put into the electronic memory of the "Soyuz-31" data that are needed for the maneuver, after which the engines were again fired.

"Everything is going in accordance with the program," they report from on board.

Two bright dots approached on the lit-up map in the main hall of the Flight Control Center. Now there are only a few kilometers between the ship and the station. The distant approach instrumentation was turned on.

After 1900 hours the space vehicles passed over the Atlantic Ocean and communication with the Flight Control Center was accomplished via the ships of the USSR Academy of Sciences "Kosmonavt Pavel Belyayev" and the "Kosmonavt Vladimir Komarov." The "Soyuz-31" approached the station with a gradually diminishing velocity: 25, 21, 18 and 15 meters per second. The distance between the objects was reduced. When it was nine kilometers the "Yastreby" reported:

"We are observing the station in the sight as a tiny white dot."

"Is the signal 'Intercept' lit?"

"It is."

Finally, the ship entered the zone of observation of ground stations in the Soviet Union. Four kilometers to the station, two kilometers, one kilometer...

"'Yastreby!' Switch on the television camera to warm it up!"

A flash appears on the screen at 1931 hours; these are the lights of the "Salyut-6." The distance is 210 meters. The signal "Docking" flares up in the ship's cabin. At 19 hours 37 minutes 37 seconds we finally hear the long-awaited report:

"There is contact...There is mechanical interception!"

The ninth docking of a spaceship with the "Salyut-6" has taken place over Ulan-Ude. Unfortunately, we could not see it because the ship and station were in the deep shadow...

[566]

COMMENTARY ON PHOTOGRAPHIC SURVEYING WITH MKF-6M CAMERA

Moscow IZVESTIYA in Russian 26 Aug 78 p 6

[Article by Yu. Chesnokov]

[Text] One of the many tasks which are being carried out by the crew of the "Salyut-6" orbital station is the photographing of the earth's surface for the purpose of investigating the earth's natural resources.

In particular, for this purpose use is made of the MKF-6M multizonal space camera, installed aboard the orbital station. It was developed jointly by specialists of the USSR and East Germany. The MKF-6M camera weighs 170 kg and is a complex combination of precise optical, mechanical and electronic units ensuring the meeting of rigorous and contradictory requirements imposed on space photographs and following from the tasks of investigation of terrestrial resources. Each photograph must cover a great sector of the earth's surface (about 20,000 square kilometers). On the photograph it must be possible to differentiate very small details in the terrain (measuring about 10-20 meters) and detect small (several percent) differences in their brightness. Space photographs must ensure the possibility of a precise determination of the absolute brightness of any photographed feature.

The geometrical accuracy in forming the image on space photographs must also be very high. Each sector of the terrain must be photographed twice, at different angles relative to the vertical, that is, from two adjacent points in orbit. By examining one of these photographs with special stereoscopic instruments first with the right eye and then with the left eye it is possible to observe a three-dimensional model of the terrain, to measure and study it. Finally, a space survey should enable us to obtain information on the spectral distribution of the brightness of terrestrial objects, that is, on the dependence of the brightness of objects on the wavelength of the solar radiation reflected by them. And it is necessary to detect very small spectral differences.

The MKF-6M camera has six objectives and accordingly six magazines with different films. The optical axes of the objectives are rigorously parallel to one another and the scales of the images created by these objectives on the photographic films are strictly identical. The six shutters are opened and closed synchronously, precisely at the stipulated moments in time. The time of opening of the shutters (exposure) is fixed with an accuracy to 1%. The MKF-6M objectives are supplied with light filters, each of which admits the radiation emanating from terrestrial features only in a definite narrow zone of the electromagnetic spectrum. Four of these zones correspond approximately to those parts of the electromagnetic spectrum in which the radiation gives us the sensation of blue, green, orange and red. Two zones are situated in the near infrared spectral region which are not sensed by the human eye. Thus, for each part of the terrain we simultaneously obtain

six black-and-white photoimages corresponding to the six mentioned spectral zones.

The MKF-6M also has a whole series of other devices and attachments ensuring the obtaining of high-quality photographs with the necessary characteristics. For example, due to the enormous velocity of movement of the orbital station relative to the earth's surface even during those fractions of a second in which the camera shutter is opened, the optical image created by the objective moves relative to the photographic film by a considerable value, which leads to a blurring of the photographic image. The MKF-6M contains a device which in those fractions of a second when the shutter is open stops the mentioned movement of the optical image relative to the film. The satisfaction of the rigorous requirements imposed on space multizonal photographs is ensured, in particular, by the use in the MKF-6M of high-quality Soviet photographic films.

On the basis of black and white zonal photographs the differences in the distribution of brightness of objects by spectral zones are visually evaluated very poorly by man, especially if these differences are small. Accordingly, the differences in zonal brightnesses are usually transformed into color differences, synthesizing from black and white photographs, obtained in different spectral zones, color images of the photographed terrain. For example, if three black and white photographs corresponding to different spectral zones are projected onto a single screen, on this screen carefully matching the images of one and the same features, and the projection is accomplished for one photograph using blue light and for a second -- green, and for a third -- red, a color image of the terrain arises on the screen, showing the terrain, and this can be registered on color photopaper or film.

The colors on such images are arbitrary (not natural), that is, they are not those which would appear on ordinary color photographs and not those which would be seen in direct visual observation. On the other hand, on the color multizonal photographs in the form of sharp color contrasts it is possible to detect differences in the spectral brightness of terrestrial features which cannot be sensed by the human eye and which are not transmitted on ordinary color photographs.

The first tests of the MKF-6 camera were successfully carried out in September 1976 by the cosmonauts Valeriy Bykovskiy and Vladimir Aksenov on the spaceship "Soyuz-22." The principal purpose of the experiment, carried out on the "Soyuz-22" spaceship with the MKF-6 camera, was the testing of this camera. We are convinced that it functions faultlessly under spaceflight conditions. It goes without saying that the photographs taken during the "Soyuz-22" flight were also used in solving specific problems in investigating the earth. But the "Soyuz-22" flight was brief. An orbital station operates a long time. The exposed film can be returned to the earth and a supply of fresh film can be sent to the station. All this is affording new possibilities for using the MKF-6M. Now it is possible to select

purposefully the regions which are to be photographed and obtain photos specifically of those regions which are of the greatest interest to specialists engaged in the investigation of terrestrial resources.

It is also possible to select the times for taking photographs purposefully. This is very important, since specific problems are solved most effectively if the time of the survey is selected correctly. For example, if a study is being made of processes associated with snow melting, the survey must be made in spring; the species of trees are more easily distinguished on multizonal photographs taken in spring or autumn, not in summer; for solving agricultural problems the photographing must be carried out at definite times related to the regime of agricultural use of the land, etc. The prolonged existence of an orbital station makes possible the multiple photographing of one and the same regions. This makes it possible to study the dynamics of different processes transpiring on the land, in the ocean and in the atmosphere.

The possibilities of a multizonal survey have still not been completely studied and we are awaiting new and interesting results from the experiment carried out with the MKF-6M camera aboard the "Salyut-6" orbital station.
[546]

GUROVSKIY DISCUSSES EFFECTS OF RADIATION ON COSMONAUTS

Moscow PRAVDA in Russian 18 Aug 78 p 3

[Article by N. Gurovskiy, E. Kovalev and V. Petrov]

[Summary] It is essential to monitor radiation conditions in space and carry out special precautionary measures. During the course of the entire flight this work is performed by the Radiation Safety Service in the USSR Health Ministry, which combines the efforts of specialists in two professions -- physicists and physicians specializing in the field of radiation. An increase in the fluxes of solar cosmic rays during a flare is a rather rapid process and the radiation danger can increase over the course of several hours up to the maximum value. During this time it is necessary to carry out effective protective measures. But before issuing recommendations it is necessary to process information on radiation conditions in interplanetary space and the geophysical characteristics near the earth, to compute, taking into account the flight trajectory, the protective properties of the ship and the work program for the cosmonauts, and most importantly -- the predictable irradiation levels. Only after this is it possible to formulate recommendations on the further implementation of the program. One to one and a half hours is devoted to this work. Figures light up brightly on a panel completely occupying one of the hall walls; these are the parameters characterizing the radiation conditions in the ship's compartments and also the overall state of the crew. Individual columns of figures indicate the magnitudes of the radiation doses measured by the on-board

instruments, and also prediction for several revolutions in advance. Duty officers are situated at the control panel. They have all the necessary information obtained from both aboard the "Salyut-6" and from the ground solar service. What are the conditions on the station at this moment? They are determined for the most part by three factors: the period of solar activity, inclination of the orbital plane to the equatorial plane and orbital altitude. At present there are weak and moderate flares on the sun. But the angle of inclination of the orbital plane, 51.6° , ensures a virtually complete screening of the "Salyut-6" by the earth's geomagnetic field. And the orbital altitude is 380-350 kilometers. The radiation belts are situated at greater altitudes and therefore the radiation fluxes constitute no danger for the station's crew. The total levels of the radiation effect on the cosmonauts, determined by all the sources, are 25-80 millirem per day -- much less than the normal radiation levels allowed for space flights.

[545]

SOVIET SPACE ENGINEER GLUSHKO INTERVIEWED

Moscow IZVESTIYA in Russian 3 Sep 78 p 2

[Article by B. Konovalov: "Mastering the Space 'Continent'"]

[Summary] An interview was held with Academician Valentin Petrovich Glushko, the founder of Soviet rocket construction, the leader in development of the powerful liquid-fuel rocket engines used in launching satellites, manned space ships and orbital stations. In particular, he dealt with the question of how long man can remain in space. This is tied into the overall problem of increasing the efficiency in use of expensive orbital stations. In addition to the important problem of organizing the optimum balanced daily regime aboard a manned orbital station, ensuring maintenance of the crew's performance and health, it is necessary to raise the efficiency of use of the station itself. The greatest efficiency and therefore economy in the use of a manned orbital station can be attained when there is assurance of prolonged purposeful work of the crew aboard it, and of course, a maximum duration of operation of the station itself. A little while ago the "Salyut" could be expected to operate for months, but now it is capable of operating for years, and work on lengthening this time is being successfully carried out. However, the principal condition for the effective use of a manned orbital station is a maximum reduction of the duration of its unmanned flight, accompanied by a decrease in the number of experiments carried out with this same level of expenditure of resources. This problem can be solved in two ways: either by a great number of exchangeable expeditions on the station or by a lesser number of more prolonged expeditions. In the first case there must be a great number of expensive manned ships and carrier-rockets for putting the ships into orbit. Accordingly, it is economically advantageous to have longer expeditions. Moreover, during prolonged expeditions much less time is lost on the inevitable decrease in the performance of each crew

during the period of adaptation to weightlessness. The number of necessary supply ships is identical in both cases because it is dependent on the total duration of the expeditions. All this will be a step toward the industrialization of space. An increase in the duration of expeditions is admissible only gradually, as experimental data are accumulated, objectively confirming such a possibility with the mandatory condition that the crew's health and performance is maintained. If the results are positive, in the near future it appears reasonable to settle on a year's duration of the main expeditions as a maximum. It is useful to take into account the work of 24 arctic and 23 antarctic expeditions with their yearly replacement of crews. But in comparing expeditions in the polar regions with space expeditions it must be remembered that on earth there is no weightlessness problem. But in other respects the conditions on polar expeditions are more severe. On orbital stations the cosmonauts have comfortable conditions and these are gradually being improved. At this stage in the development of technology the cosmonauts live in a restricted space, but no closer than for seamen who live for many months on submarines.

[551]

DETAILS OF REDOCKING MANEUVER REPORTED IN SOVIET PRESS

Moscow PRAVDA in Russian 8 Sep 78 p 6

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Sep 78

Moscow KRASNAYA ZVEZDA in Russian 8 Sep 78 p 1

Moscow TRUD in Russian 8 Sep 78 p 1

Moscow IZVESTIYA in Russian 10 Sep 78 p 2

[Excerpt] Two variants were discussed. The ship departs from the station, hovers at a distance of 100-200 meters and then the "Igla," an automatic approach and docking system, begins to operate. And obeying its commands, the station turns in space and the ship heads for the docking unit which is on the transfer compartment. There is also another variant: fly around the "Salyut-6" in the ship. The station is seemingly motionless, the "Soyuz-31" flies alongside it and then approaches from the opposite side. (Moscow PRAVDA in Russian 8 Sep 78 p 6)

[Excerpt] "The transport ship 'stood' at the 'rear' docking unit of the station," explains the deputy flight director V. Vlagov. "And, indeed, it is precisely there where one finds the 'Salyut' engine and the lines for refueling. It is necessary to free this unit so that in case of necessity the station, for example, can receive the next freighter. And the operation in itself is of interest: in essence this is a checking of the possibilities of the orbital space complex."

"Does this mean that it was planned in advance?"

"Absolutely. And two variants were considered. In the main scheme for redocking of the 'Soyuz-31' the ship shoves off from the station, withdrawing 100-200 m from it. The Flight Control Center through the command radio link switches on the radioelectronic approach system. The station is turned and begins the ordinary docking process. In the reserve variant the 'Fotony' should undock, fly around the 'Salyut-6,' approach it from the opposite side and dock to the front docking unit."

"Why is the rotation of the station provided for in the main scheme? Is it not more complex?"

"On the contrary, it is simpler," smiles V. Blagov. "And more reliable. In order to fly around the 'Salyut' it would be necessary to expend more fuel and its reserves on the transport ship are not unlimited. In this case it would be necessary to control the 'Soyuz-31' manually, whereas now the main load has been taken on by the automatic system."

(Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Sep 78)

[Excerpt] On the morning of 7 September V. Kovalenok and A. Ivanchenkov began preparations for a new experiment. The cosmonauts transferred to the "Soyuz-31," closed the hatch between the station and the ship, donned space-suits and proceeded to check the systems.

At 1330 hours the Control Center received a report from the "Fotony" concerning the crew's readiness for undocking. At this time the "Salyut-6"- "Soyuz-31" space complex was situated over the Atlantic.

At 13 hours 50 minutes 30 seconds a panel lit up aboard the craft: "Undocking." After this spring-type pushrods separated the station and the ship. The jet engines which on 27 August propelled the "Soyuz-31" toward the "Salyut-6" worked in the opposite direction. Smoothly and majestically the spaceship departed some distance from the station.

"Distance 240 meters," reported the monitor through the loudspeaker system.

Conforming to commands from the earth, the orbital station began to turn. The working compartment, to which the "Soyuz-31" was docked, was on the opposite side and the transfer compartment began to "look" toward the ship.

Then orientation was carried out. The controlling engines of the "Soyuz" were fired at the computed time. Data on distance and velocity are transmitted through a loudspeaker. The "Fotony" report to "Zarya" about the dynamics of motion: rotation, banking, pitching, range, velocity...

The earth confirms that according to its data everything is proceeding in accordance with the standard program. On the large television screen at the Center it is possible to observe this unusual process.

"The 'Soyuz-31' has passed from the zone of visibility of the ship 'Cosmonaut Pavel Belyayev,'" reports the monitor.

And again reports, again figures, after which there is a stressed moment and the accuracy in execution of the commands and the perfection of the work which the earth and space have performed jointly is confirmed.

Rotation, banking, pitching, range, velocity...

Little flickers of light, marking the fractions of a second, run across the face of the electronic chronometer. And then we hear the voice of the "Fotony." The crew commander reports:

"We are in the propulsion zone."

"OK"

"Docking is in progress."

And finally:

"There is contact...Interception. The 'Docking' panel is lighting up..."

This operation took 30 minutes.

(Moscow KRASNAYA ZVEZDA in Russian 8 Sep 78 p 1)

[Excerpt] The maneuvering of a ship near an orbital station, its transfer from one docking unit to another, is in itself very interesting. It considerably broadens the possibilities of space navigation and is a prototype of future broad transport operations in space. In such a way, by means of space ferries, it is possible, for example, to carry out communication between several orbital stations, extraterrestrial factories or even entire settlements, which very possibly will appear in the future. As space becomes more "lived in" there will be ever-broader use of such operations as redocking, maneuvering in orbit. The present experiment is an important step on this path.

However, the transfer of a ship to another docking unit, among other things, even today has a purely practical importance. The "Soyuz-31" was precisely at the dock which was designated for the reception of both manned ships and "Progress" freighters. According to space navigation rules, it is preferable that this docking unit be free (if the orbital complex consists of one ship and a station) so that it will be possible to deliver freight, including replaceable scientific equipment, not only in accordance with plan, but also in case of necessity, at any moment. That is why Vladimir Kovalenok and Aleksandr Ivanchenkov were engaged in redocking soon after the departure of Valeriy Bykovskiy and Sigmund Jaehn. (The "Yastreby," as is well known, returned to the earth aboard the "Soyuz-29" ship, which had been in space for 80 days. Its recommended flight time together with the orbital station was not more than 90 days).

In accordance with the program, small (in comparison with the main motion engines) orientation engines have begun to operate on the station. It is a beautiful spectacle: the "Salyut-6" slowly and smoothly begins to turn in such a way that the first docking unit is directed toward the ship. There is no way to escape from the feeling that the station is manned, that is, that it is controlled by people, so precisely does it make its turns in orbit. This entrancing operation develops over the southern regions of our country at an altitude of more than 300 kilometers above the earth.

The ship meanwhile is situated at a distance of 240 meters from the "Salyut-6." The station has already turned and is situated precisely on the ship's course.

The cosmonauts press a toggle switch on the control panel, giving a command for propulsion of the "Soyuz-31." The "Salyut-6" began to approach rapidly. 150 meters, 100, 80...

On the ship there are 14 microengines for docking and orientation, each with a thrust of 10 kg, and 8 with a thrust of 1 kg. (This, it goes without saying, does not include the main engine). Using them the ship can move in any direction, level out banking, fly sideways... The distance between the station and the ship is already measured in the meters. And now at 14 hours 21 minutes 29 seconds the "Fotony" reported:

"There is contact!"

Now only the small jet engines are operating, assisting the ship to come very close to the station. A special system softens, shock-absorbs the impact between the station and the ship and extinguishes the oscillations.

"There is linkage!"

After three hours the cosmonauts, checking the tightness of the contacts and removing their spacesuits, returned to the "Salyut-6."
(Moscow TRUD in Russian 8 Sep 78 p 1)

[Excerpt] There in orbit the automatic systems are going into operation: the couplings joining the station and ship into a single unit are released, the pressure in the compartment separating the station and ship is then removed, a little while later the spring-type pushrods gently push the "Soyuz-31" away from the station. Now the low-thrust engines on the ship are fired, pushing it still further. The cosmonauts attentively see to it that the withdrawal is not too great. It is possible to float off for 200 meters, but more is not necessary.

Now it is time to perform a maneuver. By command of the "Salyut-6" crew the automatic search system is switched on. The "radio eye" of the station began to "feel" space.

It is important to emphasize that none of these operations are unexpected or improvised, but were planned in advance and incorporated into the flight program.

"'Fotony,' do you have the ship's log at hand?" asked the Control Center operator in the next communications contact. "Open to page 54, where it mentions the sequence of operations during undocking. We will introduce refinements."

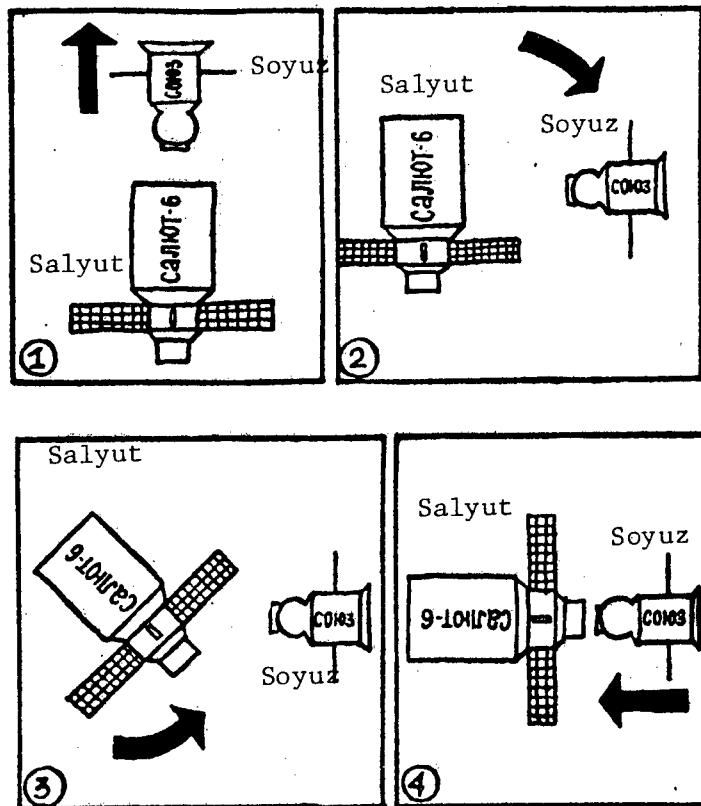
Preparations for this responsible work had begun in the morning. All the lamps and control panels were switched off and only emergency lighting remained. Kovalenok and Ivanchenkov headed for the "Soyuz-31" ship. As is well known, the "Salyut-6" station consists of three cylindrical compartments of different diameter. First there is a small cylinder, then an intermediate cylinder (diameter -- 2.9 m), to which are attached three panels of solar cells, and finally, a large cylinder with a diameter of more than four meters. The engine is at its end. Its nozzles were not mounted at the center, but along the edges of the station, because a second docking unit is situated in the middle and it was precisely to this that the "Soyuz-31" was docked. The length of the station is 15 meters. The cosmonauts closed all the internal hatches and slowly floated through the working compartment, very carefully checking whether everything had been done, seeing whether anything had been forgotten, with their glance taking in the control panels, working control posts, the numerous and complex instrumentation which was carried aboard the "Salyut-6." They have been working almost three months in space (to be more precise, twelve weeks) and on the station they know every detail and have become more accustomed to it than their terrestrial home.

The "Fotony" floated past the treadmill, curved around the complex of scientific instrumentation and passed through the hatch into the "Soyuz-31." They remained for some time in the orbital compartment, observing how slowly the hatches closed. Then they donned their spacesuits. They activated two apparatuses for ventilating the spacesuits. They checked the radio communications. Finally, they passed into the descent module.

At 13 hours 53 minutes 38 seconds, on command of the cosmonauts, the "Soyuz-31" parted from the "Salyut-6." This occurred over the Atlantic. And soon on a large screen at the Control Center we saw how the station, sparkling in the sun, slowly floated in space against the background of the earth.

The "Salyut-6" was flying sideways over the Mediterranean Sea, covered with thin clouds. The visibility was excellent. Then it passed over Turkey and the Black Sea. Along its southern shore it was possible to see a white steep spiral of a cyclone (do meteorologists know about it?)...The distance between the "Salyut-6" and the "Soyuz-31" is about 200 meters.

"How beautiful the station is!" says Kovalenok, unable to restrain himself. "It seems to be frozen in space."



The ship's television camera transmits an image of the station to the screen of the main hall at the Flight Control Center. Shining in the sun's rays, it is similar to a weird aircraft with its thin wings of solar cells. Far below lies the earth, densely covered with its patches of clouds.

"There is radiointerception," reports the triumphant voice of V. Kovalenok from orbit.

The station gradually, as if in a slow dance, turns the "prow" of the transfer compartment in the direction of the ship.

The ship, propelled by the low-thrust engines, moves forward. The image of the station on the screen increases.

"There is contact!" says the "Soyuz-31" commander in a report from the station.

(Moscow IZVESTIYA in Russian 10 Sep 78 p 2)
[567]

Abstracts of Scientific Articles

SCATTERING FUNCTION IN VENUSIAN LOWER ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 563-569

[Article by Yu. M. Golovin, B. Ye. Moshkin and A. N. Ekonomov, "Scattering Function in the Venusian Lower Atmosphere According to the Results of Photometric Measurements from the 'Venera-9' and 'Venera-10' Spacecraft"]

[Abstract] The objective of the study was to determine the scattering and absorption functions in the lower Venusian atmosphere on the basis of measurements of light fluxes from the spacecraft "Venera-9" and "Venera-10" using 15-channel wide-band photometers. It was found that the scattering function in the Venusian atmosphere from the surface to about 10 km within the range $\pm 25\%$ coincides with Rayleigh scattering for CO₂. At great altitudes the additional factor of light attenuation is present. In the spectral range 0.5-0.8 μm the lower atmosphere scatters light conservatively. In the spectral range 0.8-1.1 μm true absorption exerts a substantial influence on the light regime. The effective albedo of single scattering is about 0.95.

[548]

RELATIVISTIC ELECTRONS IN AURORAL ZONE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 539-543

[Article by S. N. Kuznetsov and V. G. Stolpovskiy, "Relativistic Electrons in Auroral Zone"]

[Abstract] This paper gives the preliminary results of observations of relativistic electrons ($E_e \geq 2.3$ MeV) at auroral and subauroral latitudes. These results were obtained using the polar satellite "Kosmos-721" (circular orbit with an altitude of about 230 km) using an instrument registering electrons with $E_e \geq 1.4, \geq 1.8, \geq 2.3$ MeV, and also bremsstrahlung of electrons with $E_e \geq 1.8$ MeV. Relativistic electrons and their bremsstrahlung were registered by a global detector with the geometry factor $\sim 15 \text{ cm}^2 \cdot \text{sr}$.

The analysis was made using data obtained on 26-28 March and 1-2 April 1975; on 26 March and 1-2 April geomagnetic conditions were quiet; on 27-28 March there was a moderate storm in the geomagnetic field. It was found that with intersection of the auroral zone at longitudes outside the region of the South Atlantic anomaly relativistic electrons were registered in the range $\Delta L \sim 0.3$ -1 regardless of local time. The authors found no definite dependence between the flux intensity of relativistic electrons and magnetic activity. There was no correlation between fluxes of relativistic electrons and electrons of lesser energies. Also discussed are the possible mechanisms of the leakage of relativistic electrons in the high latitudes.

[548]

RADIATION DANGER FROM SOLAR FLARE OF 4 AUGUST 1972

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 535-538

[Article by A. V. Kolomenskiy and V. M. Petrov, "On the Problem of Evaluating the Radiation Danger from the Solar Flare of 4 August 1972"]

[Abstract] The article gives an estimate of the dose of solar flare protons behind shielding with a nonuniform distribution of the shielding thicknesses of material. It is shown that the computation methods now in use make possible a quite correct estimate of the dose of solar cosmic rays when the spectral characteristics of the radiation and the distribution of shielding thicknesses are known. In evaluations and interpretation of the characteristics of cosmic radiation measured on satellites it is exceedingly important to make a detailed allowance for the shielding of the detectors by the parts of the satellite and on-board instrumentation. The computed value from the local dose from the flare of 4 August 1972 behind a shielding of 3 g/cm^2 is about 1,000 rad. The radiation danger from solar flares for the crews of manned spaceships is determined by a whole series of factors, including not only the characteristics of solar cosmic rays, but also specific protection conditions, irradiation level during the preceding flight period, etc.

[548]

EFFECT OF GRAVITATIONAL MOMENTS ON DYNAMICS OF ROTATING SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 497-504

[Article by M. Rayan and P. M. Beynam, "Influence of Gravitational Moments on Dynamics of a Rotating Satellite with Extensible Elements"]

[Abstract] Using numerical and analytical methods, the authors have investigated the influence of gravitational moments on the dynamics of a rotating satellite consisting of a solid central body and rigid extensible

telescopic rods. It is assumed that the rods are extended along the main central axes of inertia of the central body. For the special case of symmetric extension of rods it was possible to determine the limits of the region of stability and a study was made of the behavior of this system. Possible cases of instability arising with extension of the rods are investigated.

[548]

STABILITY OF TWO-ROTOR GYROSCOPIC VERTICAL ON EARTH SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 492-496

[Article by A. I. Gurin, "Stability of Two-Rotor Gyroscopic Vertical Placed Aboard an Earth Satellite in a Newtonian Central Field of Force"]

[Abstract] The author has derived differential equations of motion for a two-rotor gyroscopic system when the center of suspension of this system moves along a geocentric sphere with the radius R_1 and the system is in a Newtonian central field of force. It was possible to establish adequate conditions for the stability of a gyroscopic vertical situated on the earth satellite. The investigation was made taking into account the moments of inertia of all the elements entering into the gyroscopic system.

[548]

DATA PROCESSING DURING CONTROL OF DESCENT IN ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 467-474

[Article by V. N. Baranov and V. G. Gavrikov, "On the Problem of Information Processing During Descent in the Atmosphere"]

[Abstract] A study was made of the problems involved in developing a unit for the optimum processing of information by an autonomous control system during descent of a space vehicle in the atmosphere for entry velocities close to first cosmic velocity. The control is intended for minimizing the scatter of spacecraft landing points. The authors propose small models of motion of a spacecraft in the atmosphere used in synthesis of the information processing unit. The latter is realized on the basis of a modified Kalman filter, ensuring a stable regime for obtaining the optimum evaluations used directly in the optimum control unit. The article gives the results of computer statistical modeling of the process of modeling of information during descent of a spacecraft in the atmosphere.

[548]

STRUCTURE OF STRATOSPHERE AND MESOSPHERE IN PRESENCE OF NOCTILUCENT CLOUDS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 12, No 3, 1978 pp 186-187

[Article by N. I. Novozhilov, Main Geophysical Observatory, "Characteristics of Structure of the Upper Stratosphere and Mesosphere in the Presence of Noctilucent Clouds"]

[Abstract] The external form of noctilucent clouds, the rapid variability of their form, and also the layered structure of the mesopause makes it possible to assume that the formation of clouds is associated with some rapid process of a decrease in the temperature of the medium, propagating simultaneously and to an identical degree over a great area. This process is not associated with radiation, not frontal air uplifting, not turbulence. It has been ascertained that the most probable process of formation of noctilucent clouds is the process of an adiabatic decrease in temperature under the influence of a sharp decrease in pressure, since this can explain all the already mentioned peculiarities of noctilucent clouds. A decrease in pressure over an enormous area, inevitably associated with the formation of a cyclonic eddy, can be observed under the influence of either internal gravitational waves or tidal oscillations, or other factors. The postulated presence of a cyclone in the mesopause is also dictated by other considerations. In the overwhelming majority of cases noctilucent clouds enter into the region of the earth's shadow. For explaining this phenomenon the author has postulated that there is increased refraction of direct solar rays when noctilucent clouds are present. In 70% of the cases this refraction should attain 2-5°. An estimate shows that such a considerable refraction could be observed with a drop in density (pressure) on the path of the sun's rays by more than two orders of magnitude than under ordinary refraction conditions. However, the most probable synoptic conditions for noctilucent clouds involve the presence of a well-developed cyclone in the mesosphere.

[574]

EVALUATION OF GEOID PROFILE IN SATELLITE LEVELING

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA" in Russian No 3, 1978 pp 60-63

[Article by L. P. Pakhmutov; "Influence of Accuracy and Volume of Measuring Information on Evaluation of Profile of the Geoid in Satellite Leveling"]

[Abstract] On the basis of equations derived by M. M. Mashimov the author has created a model of satellite leveling. On a profile of the geoid with an extent of about 55° a study was made of the influence of accuracy in measuring elevations from a satellite and their volume on the evaluation of the profile. These factors exert the greatest influence on determination of the relative elevations of the geoid. On a short orbital arc it was possible to

demonstrate the influence of accuracy in measuring the altitudes of artificial earth satellites above sea level on the magnitude of the error in the geocentric radius of the artificial earth satellite. An increase in the accuracy of measured altitudes of artificial earth satellites by an order of magnitude improved the evaluation of the absolute profile by 0.65 m. The effectiveness of the influence of the investigated factors on the evaluation of the profile of the geoid must be expected with a mean square error in elevations on the world map of the geoid of not more than 5 m. The possibility of satellite leveling in more precise determination of the figure of the geoid in an ocean area is demonstrated.

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